



## NASA-USGS Post-Doctoral Fellowship Opportunity Proposal 2018



### ***Water from Orbit: Verified AI tools for detecting water resource changes from orbit***

#### **The Challenge:**

Orbital imaging opportunities are increasing in extent and frequency with the arrival of small satellite constellations and increasing numbers of earth observation satellites. These assets can capture meter-scale changes in water body extent from floods, droughts, and human activities that are early indicators of ongoing human and environmental changes. Yet, we have low-situational awareness of many of these hydrologic changes because the amount of imagery greatly exceeds our ability to interpret it. Challenges include varying spectral characteristics of surface waters, vegetation and cloud cover interference, urban infrastructure interference, and incomplete science and knowledge relating remotely-sensed observations to surface water extent. Further challenges include the need to rapidly apply and verify machine learning algorithms on large streams of data to yield information that can be used by managers of water resources, disaster response, and natural and agricultural resources.

The U.S. Geological Survey (USGS), National Aeronautics and Space Administration (NASA), and National Geospatial Intelligence Agency (NGA) are cooperating to develop expertise in remote sensing, hydrology, and computation that is needed for operational near-real-time detection and mapping of surface water changes.

#### **The Opportunity:**

This opportunity seeks a postdoctoral fellow to work with an interdisciplinary team from USGS, NASA, NGA, and industry in Silicon Valley to advance our ability to detect and verify water extent from orbital assets, including low-latency multispectral and synthetic aperture radar (SAR) satellite imagers. This work will also seek to incorporate novel ways to incorporate terrain and hydrologic data analysis with imagery analysis for improved surface-water characterization.

The fellow will research machine learning algorithms for satellite imagery, with an initial application of flood mapping. The fellow's work will be incorporated into an open source deep learning toolkit for satellite imagery which can be used by Earth scientists to achieve state-of-the-art classification results with little knowledge of machine learning. Potential research topics include, but are not limited to:

- Development of novel data assimilation techniques to reduce classification errors
- Overcoming classification challenges in urban or vegetated areas
- Methods for bridging time gaps between satellite overpasses
- Fusing data sets of multiple types and resolutions
- Incorporating additional derived data into the algorithm

The fellow will collaborate with Federal and industry partners who are working to identify a set of imaging assets that can be validated with ground-based training data sets from USGS; develop automated classification tools to apply to training images; and develop a platform for near-real-time data assimilation and classification. The fellow will work out of adjoining NASA/USGS facilities in Silicon Valley, with opportunities to visit NGA and industry partners in the Valley. They will have access to substantial, co-located NASA and USGS assets, including the NASA Earth Exchange (NEX), USGS spectral libraries, the USGS/NASA UAS Research Center, an ASD spectroradiometer, LI-COR quantum sensors, and Trimble sub-meter GPS and image processing software. The NEX platform provides access to high-performance computer resources co-located with ready to use massive data sets of multi-spectral, hyperspectral and lidar data sets and containerized workflows and other analytical tools.

Post-doctoral fellows will be located in Silicon Valley, one of the epicenters of global science and technology activity. Carnegie Mellon University's Silicon Valley campus will be across the street. The DoD Defense Innovation Unit is just a few blocks away. Stanford University, globally recognized science and technology companies, and many innovative new startups are within a few miles drive.

**Proposed Duty Station: Moffett Field, California**

**Areas of Ph.D. Applicant:** [Write the appropriate discipline expertise] Applicants are preferred who have experience in remote sensing and the application of machine learning, computer vision or other AI tools to remote-sensing data. Experience working with digital elevation model (DEM) data and a working knowledge of fluvial geomorphology or hydraulic modeling concepts is favorable. Candidates holding a Ph.D. in other disciplines but with knowledge and skills relevant to the Research Opportunity may be considered.

**Qualifications:** Applicants must meet qualifications for one of these federal positions: Research Geographer; Research Engineer; Research Hydrologist. (This type of research is performed by those who have backgrounds for the occupations stated above. However, other titles may be applicable depending on the applicant's background, education, and research proposal. The final classification of the position will be made by the Human Resources specialist.)

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